

Are corticosteroid injections more beneficial than anaesthetic injections alone in the management of rotator cuff-related shoulder pain? A systematic review

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ABSTRACT

Objective To compare the effectiveness of corticosteroid injections to local anaesthetic injections in the management of rotator cuff-related shoulder pain (RCRSP).

Design Systematic review with best evidence synthesis.

Data sources The Cochrane, PubMed, CINAHL Plus, PEDro and EMBASE electronic databases were searched (inception until 8 June 2017). Reference lists of included articles were also hand searched.

Eligibility criteria Two reviewers independently evaluated eligibility. Randomised controlled trials (RCTs) were included if they compared subacromial injections of corticosteroid with anaesthetic injections. Two reviewers independently extracted data regarding short-term, midterm and long-term outcomes for pain, self-reported function, range of motion and patient-perceived improvement.

Results Thirteen RCTs (n=1013) were included. Four trials (n=475) were judged as being at low risk of bias. Three studies of low risk of bias favoured the use of corticosteroid over anaesthetic-only injections in the short term (up to 8 weeks). There was strong evidence of no significant difference between injection types in midterm outcomes (12–26 weeks). There was limited evidence of no significant difference between injection types in long-term outcomes.

Conclusion Corticosteroid injections may have a short-term benefit (up to 8 weeks) over local anaesthetic injections alone in the management of RCRSP. Beyond 8 weeks, there was no evidence to suggest a benefit of corticosteroid over local anaesthetic injections.

Trial registration number PROSPERO CRD42016033161.

BACKGROUND

Shoulder pain is a common musculoskeletal disorder with prevalence estimates ranging from 6.9% to 26.0% for point prevalence, annual prevalence of 4.7%–46.7% and lifetime prevalence of 6.7%–66.7%.¹ Prevalence increases with age,² and shoulder pain is frequently associated with long-term disability.^{3–5} Injection therapy is a common intervention for musculoskeletal shoulder pain and is administered in primary and secondary care. In the UK, general practitioners administer corticosteroid (CS) injections to approximately 1 in 10 people presenting with shoulder pain in primary care.³ Injection therapy for shoulder pain is also performed by physiotherapists, orthopaedic

surgeons, rheumatologists, radiologists, sports and exercise medicine doctors and others in primary and secondary care, as well as in private settings. However, the definitive number of people receiving CS injections for musculoskeletal shoulder conditions remains unknown.

Rotator cuff-related shoulder pain (RCRSP)⁶ is an overarching clinical term and includes a number of other conditions: subacromial impingement syndrome,⁷ subacromial pain syndrome⁸ and rotator cuff tendinopathy.^{9–10} In addition to local tissue pathology, persistent pain associated with RCRSP may be related to altered processing and output of the central nervous system.^{11–12} Education, advice and exercise are the most common treatments for RCRSP⁶ and have comparable results to surgery.^{6–13} Another very common treatment for this condition is injection therapy, which typically involves injections of CS in isolation, or more commonly, mixed with anaesthetic¹⁴ into the subacromial space.¹⁵ For patients with RCRSP, CS or CS and anaesthetic preparations are often administered for treatment,³ and anaesthetic injections alone are used for diagnosis, in a procedure known as the Neer impingement test.⁷

Although CS injections for RCRSP are common, the definitive mechanism of action is uncertain, with suggestions that they may have an anti-inflammatory role,¹⁶ reduce tenocyte numbers¹⁷ and inhibit nociceptor activity.¹⁸ There is also uncertainty regarding clinical effectiveness with previous reviews suggesting their benefit maybe unclear,^{19–20} short lived,^{21–23} no greater than non-steroidal anti-inflammatories^{21–22} or beneficial for up to 9 months.²⁴ In addition, there is emerging evidence linking the use of CS injections with negative effects on rotator cuff tissue.^{25–27} Due to these risks, anaesthetic-only injections (although not devoid of risk) might, when deemed appropriate, be considered a reasonable alternative to CS in the management of RCRSP.⁶ A recently published meta-analysis assessed short-term outcomes and concluded that CS injections provide, at best, a minimal transient pain reduction in a small number of patients with rotator cuff tendinosis.²³

No previous review has directly compared CS alone, or CS and anaesthetic injections, with local anaesthetic-alone injections in the treatment of RCRSP. A comparison of this nature is relevant for a number of reasons, including the common use of injection therapy in the management of RCRSP,³



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Review

Table 1 Search strategy for the review

Sources, searches and search terms	Total yield/hits (number of new/relevant records)
PubMed: (subacromial pain syndrome OR shoulder pain OR shoulder impingement syndrome OR subacromial impingement OR subacromial bursitis OR burs* OR rotator cuff tendin* OR impingement OR tendin* OR tendon OR subacromial OR shoulder) AND (Injection therapy OR injectio*) AND (Steroid OR corticosteroid) AND (local anaesthetic OR anaesthetic OR anesthetic) AND (pain OR function)	286 (286)
The Cochrane Library: browsed by topic – musculoskeletal, search narrowed-shoulder, search narrowed-injection	8 (0)
EMBASE: (subacromial pain syndrome OR shoulder pain OR shoulder impingement syndrome OR subacromial impingement OR subacromial bursitis OR burs* OR rotator cuff tendin* OR impingement OR tendin* OR tendon OR subacromial OR shoulder) AND (Injection therapy OR injectio*) AND (Steroid OR corticosteroid) AND (local anaesthetic OR anaesthetic OR anesthetic) AND (pain OR function)	236 (0)
PEDro: 'shoulder pain AND injection', 'shoulder AND steroid'	80 (0) 34 (0)
CINAHL plus: (subacromial pain syndrome OR shoulder pain OR shoulder impingement syndrome OR subacromial impingement OR subacromial bursitis OR burs* OR rotator cuff tendin* OR impingement OR tendin* OR tendon OR subacromial OR shoulder) AND (Injection therapy OR injectio*) AND (Steroid OR corticosteroid) AND (local anaesthetic OR anaesthetic OR anesthetic) AND (pain OR function)	58 (0)
Hand searches of relevant reference lists	5 (1)
Total:	287

as well as: (1) the potential comparable clinical effectiveness of these medicines¹⁴ and (2) the potential deleterious effect of CS on tendon tissue.²⁶

To inform the shared decision-making process, those seeking and providing treatment for RCRSP would be better informed with more knowledge on injection therapy, especially comparing the most commonly performed procedures (CS alone or CS and anaesthetic injections, with local anaesthetic-alone injections) in the management of RCRSP. Therefore, the aim of this review was to compare these pharmacological preparations in the management of RCRSP for clinical effectiveness (symptoms, range of movement and function) in the short term, medium term and long term.

METHODS

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and Cochrane collaboration guidelines were followed.^{28–30} PROSPERO registration number: CRD42016033161.

Population

Inclusion criteria: studies with adult participants diagnosed with RCRSP were included.⁶ Exclusion criteria: participants with non-RCRSP shoulder conditions such as shoulder dislocation or instability, fractures, rheumatological conditions or frozen shoulder. Also, people who had undergone previous surgery, as well as those with confirmed full thickness rotator cuff tears.

Intervention/control

Inclusion criteria: randomised clinical trials. Studies were included if they compared groups receiving single or repeated: subacromial injections of CS with or without local anaesthetic versus local anaesthetic injection without CS. Concurrent prescription of exercise therapy, as well as prescription of pain relieving medications, such as analgesics and non-steroidal anti-inflammatory drugs (NSAIDs), was permitted inclusions, as this reflects common clinical management of RCRSP.^{6,31}

Exclusion criteria: in the treatment of RCRSP, the subacromial space is the most common target for injections, and investigations of injection therapy that did not solely target this region^{32,33} were excluded. Other injection procedures, such as barbotage, were also excluded.

Outcome

Outcome measures included shoulder pain, self-reported function, range of motion and patient-perceived improvement. Follow-up time postintervention was defined as short term (less than 3 months), midterm (3–12 months) and long term (a year or longer).³⁴

Data sources

The Cochrane Library, PubMed, EMBASE, PEDro and 'CINAHL plus' databases were searched from inception to 8 June 2017 by two independent reviewers (TC and MM). No language, date or publication restrictions were applied. Search terms included 'shoulder', 'impingement', 'subacromial', 'injections', 'corticosteroid' and 'local anaesthetic'. These terms were linked broadly to the population, intervention, comparators and outcome elements for the review question (table 1).

The reference lists of retrieved articles, including previous systematic reviews, were assessed for additional study titles and relevant publications, including articles not identified in the search, personal communications, books and book chapters.

Study selection

Studies that were not randomised controlled trials (RCTs) were excluded from the review. Selection of studies was independently performed by two reviewers (TC and MM). Where full-text manuscripts were not accessible, the corresponding authors were contacted. If there was no reply or the full text was not available, the study was excluded from this review. Following this process (and after a 1-month wait), two studies were excluded from the review as only abstracts of these studies have been published.^{35,36} Two eligible studies^{37,38} not published in the English language were professionally translated into English by bilingual members of the Cochrane collaboration.

Data extraction

Data were independently extracted by two reviewers (TC and MM) using the Cochrane data extraction form for RCT intervention reviews (<http://training.cochrane.org/resource/data-collection-forms-intervention-reviews>). Any discrepancies in this process were resolved by discussion between the two reviewers, followed by reassessment of the data. A system to resolve any disagreements was established a priori via discussion with a third reviewer (JL), but no such discrepancies occurred. Data

extraction for the two non-English studies were performed by the bilingual members of the Cochrane collaboration.

Risk of bias assessment

Two reviewers independently assessed risk of bias using the domain-based Cochrane tool for RCTs (see [table 2](#) and [figure 1](#)). Trials were evaluated as low risk of bias if all individual criteria were low and high if at least one was rated as high (and that criterion was deemed by the reviewers to introduce bias).

For further information on this tool, please refer to the Cochrane collaboration handbook.³⁹ Exceptions were made if a specific criterion was rated as being of high risk of bias but this was judged, by the reviewers, not to influence or affect the overall risk of bias.

For example, if a clinician performing the injections in a study was not blind to the treatment but the patient was blinded, and blind outcome assessment was used, then the overall risk of bias would be scored as low. Items rated as unclear raised the risk of bias.³⁹ An overall risk of bias rating for each trial was agreed by two reviews (TC and MM). [Table 3](#) details pharmacological information and injection method relating to the studies deemed to be at low risk of bias. A system to resolve any disagreements was established a priori via discussion with a third reviewer (JL). Three such disagreements occurred during the risk of bias assessment, and consensus was agreed by discussion following review of the data. Further discussion with the third reviewer was therefore not required.

Data extraction and risk of bias assessment procedures were pilot-tested by TC and MM on three similar articles prior to the formal review process.⁴⁰ A Cohen's kappa coefficient was used to assess inter-rater reliability for judgement of high and low risk of bias for each criterion. The number of agreements was 36/39 (92.31%) with a Kappa score of 0.836 and thus the level of agreement was considered strong.⁴¹

Data syntheses

The studies included in our review used different medications, doses and outcome measures (see online supplementary table 1). Due to these confounding variables, a decision not to pool data to perform a meta-analysis was reached. Instead, we used a best evidence synthesis to synthesise the results following data extraction and assessment of risk of bias. Textual descriptions of studies were written to aid the synthesis of findings, and tables were used to present study characteristics, data extraction and risk of bias assessments. Studies were grouped in accordance with their level of risk of bias in order to identify those assessed as having the highest level of internal validity.

The best evidence synthesis was based on the quality of the studies reviewed⁴²:

- ▶ Strong evidence: provided by generally consistent findings in multiple high quality RCTs.
- ▶ Moderate evidence: provided by generally consistent findings in one high-quality RCT plus one or more low-quality RCTs, or by generally consistent findings in multiple low quality RCTs.
- ▶ Limited or conflicting evidence: only one RCT (either high or low quality) or inconsistent findings in multiple RCTs.
- ▶ No evidence: no RCTs.

To guide clinical recommendations, studies were combined in relation to their outcome timescales³⁴ and whether their results favoured CS, local anaesthetic or neither injection type.

RESULTS

The electronic database search, performed on 8 June 2017, identified 286 potentially eligible articles. Hand searches of relevant reference lists identified one further article, making a total of 287 potentially eligible articles. Ultimately, 13 full-text studies were included in this systematic review, and seven studies were excluded.^{35 36 43–47} [Figure 2](#) details the PRISMA flow chart.

Short-term comparisons (0–12 weeks)

Twelve studies assessed short-term (0–12 weeks) outcomes of injection therapy for RCRSP. Five of the 12 studies, four of high risk of bias^{38 48–50} and one of low risk of bias,⁵¹ reported in favour of CS injections for a range of different outcome measures ([table 3](#)).

Three further studies, one of high risk of bias⁵² and two of low risk of bias,^{53 54} reported improvements in the first 4–6 weeks in favour of CS but reported no significant difference between groups at 12 weeks. The remaining four studies, three of high risk of bias^{37 55 56} and one of low risk of bias,¹⁴ reported no significant difference in short-term outcomes between the two types of injection therapy at any time point.

In summary, three trials^{51 53 54} (n=417) of low risk of bias favoured CS injections for the first 4–8 weeks post-injection, and one trial¹⁴ of low risk of bias (n=48) found no difference between the two types of injection.

Midterm comparisons (13–26 weeks)

In the midterm, two studies^{50 57} (both of high risk of bias) reported a significant difference in outcome favouring CS injection. One study³⁷ (of high risk of bias) reported a significant difference in favour of local anaesthetic injection for pain relief. The remaining two studies,^{14 53} both of low risk of bias and including 217 participants, reported that there was no significant difference in midterm outcomes between the two types of injection therapy. Penning *et al*⁵³ mixed anaesthetic (lidocaine 1%) with sodium chloride (0.9%), and the effect of sodium chloride may have been a confounding influence. Of note, Penning *et al*⁵³ reported that this preparation (lidocaine and sodium chloride), designated as the placebo group in this trial, had the best results at 26 weeks with respect to reduction in pain and improvement in functional mobility.

Long-term comparisons (≥1 year)

This review identified only two studies with long-term outcome measures of at least 1 year. In summary, in the long term, there is evidence from only one study³⁸ (high risk of bias) favouring CS injections, and one study⁵⁴ (low risk of bias, n=179) suggesting no significant difference between injection groups.

Best evidence synthesis

Using the rating system described in our methods section⁴² and taking into account the results from all 13 studies (both of low and high risk of bias) to provide a best evidence synthesis, we summarise the following results:

- ▶ There is strong evidence (from eight trials, three of low risk of bias) to suggest a significant benefit of CS injections over anaesthetic-only injections for the first 4–8 weeks.
- ▶ There is strong evidence (from seven trials, three of low risk of bias) to suggest that at 12 weeks there is no significant difference in outcome between injection types.
- ▶ There is strong evidence (from two trials of low risk of bias) to suggest that there is no significant difference in outcome between injection types in the midterm (26 weeks).

Table 2 Quality appraisal and assessment of risk of bias

Study/source of bias	Was the method of randomisation adequate?	Was the treatment allocation concealed?	Was the patient blinded to the intervention?	Was the provider blinded to the intervention?	Was the care provider blinded to the intervention?	Was the outcome assessor blinded to the intervention?	Was the dropout rate described and acceptable?	Were all randomised participants analysed in the group to which they were allocated?	Are reports of the study free of selective outcome reporting?	Were the groups similar at baseline regarding the most important prognostic indicators?	Were cointerventions avoided or similar?	Was the compliance acceptable in all groups?	Was the timing of the outcome assessment similar in all groups?	Other sources: validated outcome measure?	Other sources: conflict of interest declared?	Overall risk of bias rating
Petri <i>et al</i> ⁴⁹	+	?	+	+	+	+	+	+	+	+	+	+	+	–	?	High
Adebajo <i>et al</i> ⁴⁸	+	?	+	–	–	+	+	+	+	+	+	+	+	–	?	High
Vecchio <i>et al</i> ⁵⁶	+	?	?	?	?	+	+	–	+	+	+	+	+	–	?	High
Blair <i>et al</i> ⁵⁷	?	?	+	+	+	+	+	?	+	+	+	+	–	–	No	High
Ströbel ⁴⁸	?	?	?	?	?	?	–	–	?	?	+	+	+	?	?	High
Plafki <i>et al</i> ⁵⁰	+	?	?	?	?	+	–	–	–	+	+	–	+	+	No	High
McInerney <i>et al</i> ⁵⁵	+	+	–	–	–	+	+	+	+	+	+	+	+	+	?	High
Algün <i>et al</i> ⁵²	+	?	+	–	–	+	+	+	+	+	+	+	+	–	?	High
Alvarez <i>et al</i> ¹⁴	+	+	+	+	+	+	+	+	+	+	+	+	+	+	No	Low
Alvarez-Nemegyei <i>et al</i> ⁵⁷	+	?	+	+	+	+	–	?	+	?	+	+	+	+	No	High
Watson <i>et al</i> ⁵⁴	+	+	+	–	–	+	+	+	+	+	+	+	+	+	Yes	Low
Hong <i>et al</i> ⁵¹	+	+	+	+	+	+	+	+	+	+	+	+	+	+	No	Low
Penning <i>et al</i> ⁵³	+	+	+	+	+	+	+	+	+	+	+	+	+	+	No	Low

In relation to conflict of interest, an answer of 'yes' would indicate a potential high risk of bias and the opposite for an answer of 'no'.

+ = Yes; – = No; ? = Unclear.

VAS, visual analogue scale (for pain).

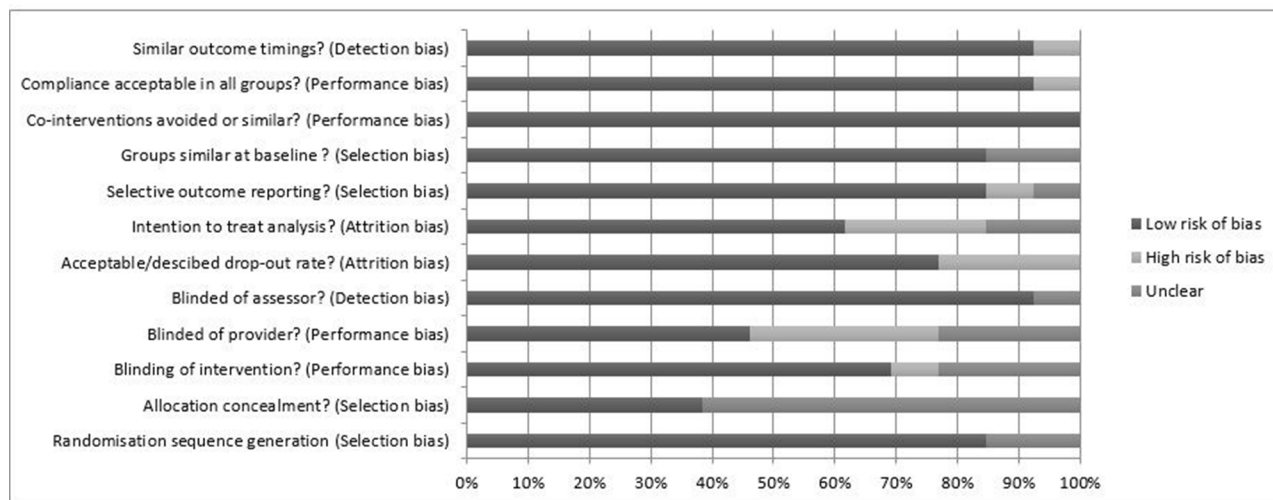


Figure 1 Risk of bias graph (frequency (%) of scores per item).

- There is limited evidence (from one trial of low risk of bias) to suggest that there is no significant difference between injection types in the long term (1 year or longer).

In summary, CS injections may have better short-term results than anaesthetic-only injections in the first 8 weeks. There does not appear to be any convincing evidence from the studies of low or high risk of bias that CS injections confer additional benefit over anaesthetic-only injections after this time point.

DISCUSSION

The studies evaluated as being at low risk of bias in this review have indicated that there may be a temporary initial benefit (4–8 weeks) of administering CS in comparison with anaesthetic injections for the treatment of RCRSP. There does not appear to be any evidence that CS injections confer any additional benefit after this time point. We are unable therefore to establish whether CS medications only afford a therapeutic advantage for 4–8 weeks and no added benefit thereafter, or whether they provide an initial benefit after which time both medications are of equal value.

The certainty of any conclusions reached is challenged by the choice, appropriateness and lack of consistency of outcome measures used for the patient populations within the individual studies. Due to variation in study design and inconsistent use of primary outcome measures, we did not pool data.

Although our study differs in its primary objectives and methodology, our findings are similar to those reported in a recent review.²³ The authors of this recent review did not identify any additional evidence that was not included in our review that may have influenced our findings. The continued use of CS is suggested by the authors to be attributable to ‘habit, to the underappreciation of the placebo effect, to satisfy patient desire for a physical intervention, or for simple remuneration’.

The majority of the included studies did not perform injection therapy in isolation. Although use of concurrent therapy (exercise, analgesics and NSAIDs) was varied, it was balanced within each individual trial. There is no definitive way of determining the impact of concurrent therapy in addition to the administered injections on the reported outcomes. Because of this uncertainty, the influence of an independent injection or an injection in conjunction with other therapy requires further investigation.

The majority of the investigations included in this review described the administration of local anaesthetic injections as a

placebo procedure, assuming that local anaesthetic injections in the subacromial space are inert and do not provide any therapeutic benefit. However, recent evidence suggests that local anaesthetics such as lidocaine and bupivacaine may have an effect of reducing tenocyte numbers^{17 58} and altering collagen organisation in tendons.⁵⁹ Increased cellularity has been associated with tendinopathy^{60 61} and, if elevated, reducing tenocyte numbers may be a possible mechanism by which injection therapy may contribute to the restoration of tendon homeostasis.⁶ The manner by which injections may improve symptoms remains elusive, and in addition to reducing inflammation, restoring tissue homeostasis, reducing the threat of pain and placebo,⁶ it has also been suggested that the therapeutic effect of subacromial injections may be the effect of distension of the subacromial space.¹⁴ Due to these possible chemical, biological and physical effects, the assumption that local anaesthetic injections are a true placebo is challenged and suggests their use may provide a therapeutic effect. However, this needs to be balanced by a potential deleterious effect.⁵⁹ Further research is required to determine the benefits of the medicines used in these studies compared with other medicines, other interventions, natural history and a validated placebo. The physiological effects of these interventions on the local tissues needs also to be further investigated.

Implications for practice

There is a paucity of data quantifying the number of CS injections performed annually in the UK. Limited evidence from one outpatient survey (n=2000) suggested the shoulder was the most common anatomical site of musculoskeletal injection, accounting for over a third of all injections. Seventy-two per cent of injections for the shoulder were for the stated treatment of subacromial bursitis (RCRSP).⁶² Recent United Kingdom National Health Service figures reveal that almost 800 000 prescriptions of injectable CSs are dispensed nationally within primary care per year.⁶³ The average cost of each prescription of CS is estimated at £5.16p, totalling a yearly national cost of over £4 000 000. The average cost of a standard dose of local anaesthetic (5 mL of 1% lidocaine) is £0.24p.⁶⁴ We believe it is safe to assume that, while exact figures for patients with RCRSP are unknown, the cost of CS injections for this patient group is sizeable and, if local anaesthetics prove safe and effective in future research, significant cost savings could be achieved. Lidocaine-only injections

Table 3 Characteristics of low risk of bias studies included in the review (n=4)

Study (reference)	Number of participants (male/female) {Mean age- years} {Mean duration of symptoms}	Interventions	Outcome measures	Findings
Alvarez <i>et al</i> ¹⁴ (Canada)	58 (31 M/27 F) {48.0 years} {Group 1: 46.0} {Group 2: 50.0} {3 years}	Group 1: blind SA injection 5 mL 2% xylocaine Group 2: blind SA injection 4 mL 2% xylocaine+1 mL (6 mg) betamethasone	Western Ontario Rotator Cuff Index (0–100, 0=best score, 100=worst score).	No statistically significant difference between groups at 3 and 6 months. Mean WORC at 12 weeks: Group 1: 45.4, group 2: 56.3 (P=0.13) Mean WORC at 6 months: Group 1: 51, group 2: 59 (P=0.38)
Watson <i>et al</i> ⁵⁴ (UK)	179 (83 M/96 F) {59.0 years} Individual group figures not reported {7 weeks}	Groups 1, 3 and 5: blind SA injection 1 mL 1% lidocaine Groups 2, 4 and 6: blind SA injection 1 mL (40 mg) triamcinolone	British shoulder disability questionnaire (0–23, 0=no disability, 23=severe disability). Short-Form 36 item (SF-36) (higher score=better outcome).	Statistically significant improvement at 4 weeks in groups 2, 4 and 6 for BSDQ (P=0.026). Specific data were supplied by the author on written request. There was no statistically significant difference between groups at 3 and 6–12 months. Over course of trial (4 weeks, 12 weeks and 1 year) mean: BSDQ: groups 1, 3 and 5: 11.7, 8.1 and 6.4; group 2, 4 and 6: 10.3, 8.7 and 7.3 (SE=0.48) SF-36 MCS: groups 1, 3 and 5: 46.4, 47.7 and 47.2; groups 2, 4 and 6: 45.8, 45.9 and 47.7 (SE=0.78) SF-36 PCS: groups 1, 3 and 5: 39.6, 41.4 and 42.9; group 2, 4 and 6: 41.4, 41.0 and 42.5 (SE=0.63)
Hong <i>et al</i> ⁵¹ (Republic of Korea)	79 (32 M/47 F) {50.1 years} {Group 1: 50.8} {Group 2: 48.6} {Group 3: 51} {11 months}	Group 1: US-guided SAB injection 4 mL (40 mg) triamcinolone Group 2: US-guided SAB injection 2 mL (20 mg) triamcinolone+2 mL 1% lidocaine Group 3: US-guided SAB injection 4 mL 1% lidocaine	Shoulder disability questionnaire (0–22, 0=no disability, 22=maximal disability) Pain VAS (0–10, 0=no pain, 10=severe pain)	Groups 1 and 2 had statistically significant improvement in both outcomes at 8 weeks, compared with group 3: Mean improvement in outcomes from baseline at 8 weeks (higher number=better improvement): SDQ: group 1: 5.7; group 2: 5.6; group 3: 0.9 (P<0.001). VAS: group 1: 3.5; group 2: 2.8; group 3: 0.6 (P<0.001).
Penning <i>et al</i> ⁵³ (The Netherlands)	159 (75 M/84 F) {53 years} {Group 1: 53} {Group 2: 52} {Group 3: 54} {6 months}	Group 1: blind SA injection 8 mL 1% lidocaine+2 mL hyaluronic acid Group 2: blind SA injection 8 mL 1% lidocaine+2 mL (20 mg) triamcinolone Group 3: blind SA injection 8 mL 1% lidocaine+2 mL sodium chloride 0.9% All injections repeated at 1, 3 and 6 weeks as needed.	Shoulder disability questionnaire (0–100, 0=no disability, 100=maximal disability) Pain VAS (0–10) Constant score (0–100, 0=poor function, 100=full function) Functional mobility test (4–28, 4=normal function, 28=poor function) SPS (7–28, 7=no pain, 28=severe pain) PSD (0–10, 0=no disability, 10=severe disability)	Group 2 had a statistically significant improvement in all outcomes compared with group 1 at 3 (P=0.004), 6 (P<0.001) and 12 (P<0.001) weeks and compared with group 3 at 6 weeks (P=0.006). There was no significant difference in outcome between groups 2 and 3 at 3, and 12 weeks. There was no statistically significant difference between all three groups in 26 weeks. Mean improvement in outcomes from baseline at 3, 6, 12 and 26 weeks (higher number=better improvement): SDQ: group 1: 0.1, 9.8, 11, 12.4; group 2: 16.1, 22.6, 27.3, 23.2; group 3: 6.3, 13.2, 15, 17 VAS: group 1: 0.3, 0.7, 0.7, 1.8; group 2: 1.6, 2.6, 2.7, 2.1; group 3: 0.8, 1.6, 2.3, 2.4 Constant: group 1: 0.1, 2.6, 3.4, 4.9; group 2: 3.6, 7, 6.4, 4.6; group 3: 2.5, 4.7, 5.1, 9.2 FMT: group 1: 0.3, 1.0, 1.2, 1.3; group 2: 1.2, 1.9, 2.4, 1.6; group 3: 0.6, 1.1, 1.8, 2.4 SPS: group 1: 1.2, 3.1, 2.9, 3.7; group 2: 3.8, 5.8, 5.4, 5.1; group 3: 2.3, 3.9, 4.2, 4.6 PSD: group 1: 0.5, 1.4, 1.3, 1.7; group 2: 1.4, 2.4, 2.3, 1.9; group 3: 1.6, 2.2, 2.1, 2

BSDQ, British Shoulder Disability Questionnaire; Blind, landmark guided; F, female; FMT, functional mobility test; M, Male; PSD, patient-specific disability score; SA, subacromial; SAB, subacromial bursal; SDQ, Shoulder Disability Questionnaire; SF-36 MCS, short-form 36-item mental component score; SF-36 PCS, short-form 36-item physical component score; SPS, shoulder pain score; US, ultrasound; VAS, visual analogue scale; WORC, Western Ontario Rotator Cuff Index.

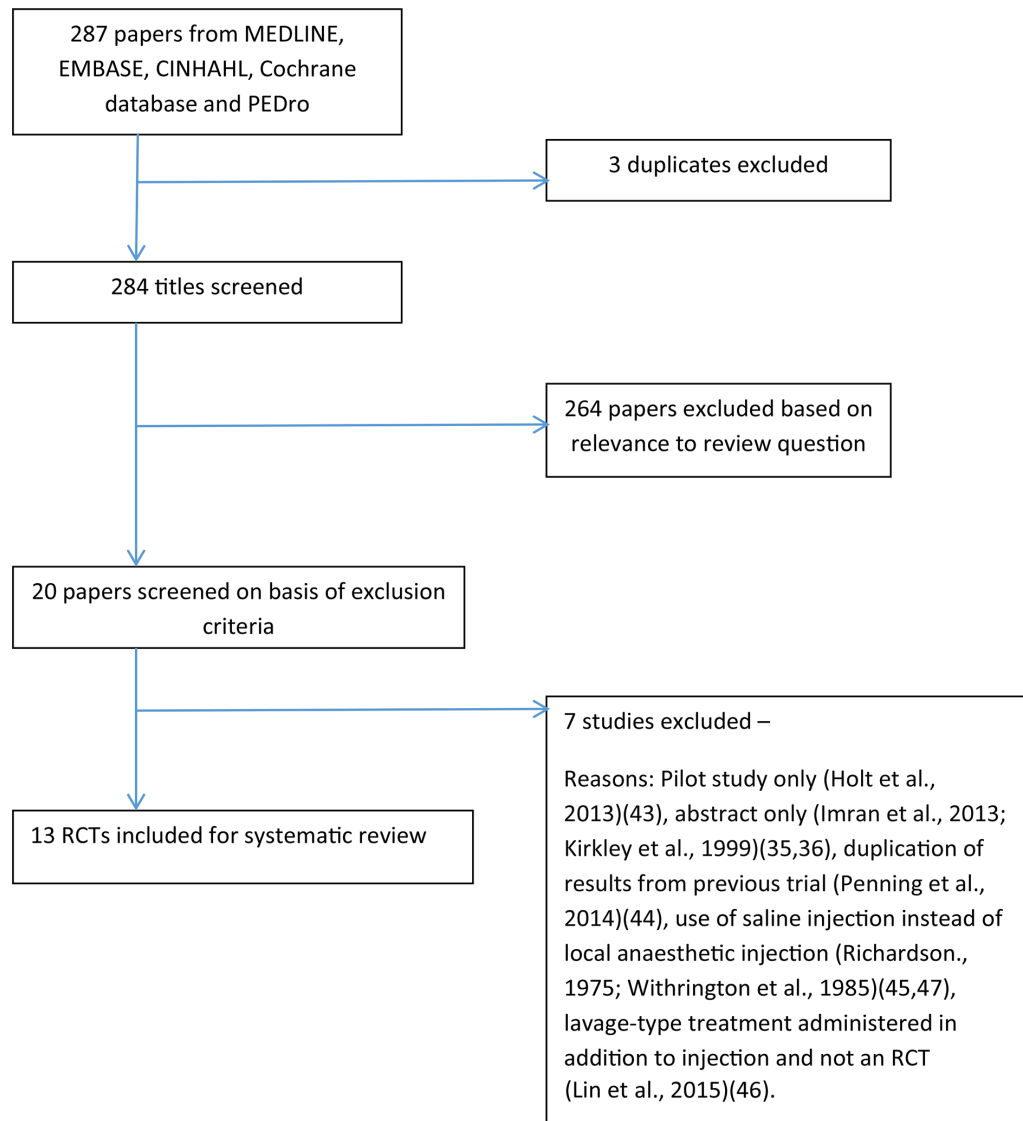


Figure 2 PRISMA flow chart of study selection process. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCT, randomised controlled trials.

would be over 20 times less expensive than the average cost of CS medication.

Clinically, in addition to cost, is the growing concern regarding the negative effects of CS on tendon tissue.^{26 27 65} It has also been suggested that the use of CS injections may detrimentally impact the course of lateral epicondylalgia.⁶⁶ This review has highlighted a lack of evidence to support the use of CS injections over local anaesthetic injections for the treatment of RCRSP after an 8-week period, which raises important issues for clinicians. Should clinicians avoid injections entirely? Should clinicians consider local anaesthetic injections for patients with RCRSP as the first choice of management, and only provide CS injections to those who do not respond to local anaesthetic? Additionally, potentially, the risks of both CS and anaesthetic-only injection outweigh the benefits, as both pharmaceutical products may damage tendon tissue. Future research is needed that compares injections of CS, local anaesthetic, saline injections, needle only (for the mechanical effect), other products (eg, hyaluronate sodium) an advice-only group, true placebo and a control group (to map natural history). In addition, uncertainty persists over the benefit of image-guided versus landmark-guided injection therapy for the

treatment of RCRSP^{32 67} and whether the procedure should be performed locally or systemically.³³

In an investigation of local (CS to the subacromial bursa and local anaesthetic to the gluteal region) versus systemic (CS to the gluteal region and local anaesthetic to the subacromial bursa) for RCRSP, Ekberg *et al*³³ concluded that as both groups improved, both local and systemic injections of CS were equally effective. Although this may support a systemic effect of CS, these findings may be confounded for a number of reasons. This review suggests that CS injections may confer clinical benefit in the first 8 weeks, but beyond this time point both types of injections and anaesthetic injections appear to be equally effective. Therefore, the conclusion that local and systemic CS injections are equally effective³³ needs to be considered cautiously as the benefit reported in this study may have been due to the administration of CS and local anaesthetic injections to the subacromial bursa. In addition, as there was no control group, the reported findings³³ may have mapped natural improvement or possibly an equivalent placebo response in both groups.

The findings of this review suggest that, in the treatment of RCRSP, CS injections may have a more beneficial effect than

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anaesthetic injections alone in the short term (up to 8 weeks). However, the size of this effect is uncertain and beyond this time point, the two medicines appear to have a comparable effect. The combination of anaesthetics and sodium chloride may be associated with better outcome at 26 weeks.⁵³ Anaesthetic alone may also have a positive effect in the short term. The uncertainty implies that it is not yet possible to guide clinicians on particular circumstances where (1) there is a definitive role for injection therapy for RCRSP and (2) when CS or anaesthetics may be equally responsive or one may be more beneficial than the other. Equally important is that both medicines may have a detrimental effect on rotator cuff tissue. Shared decision making empowers people seeking healthcare to voice their opinions and thoughts. The findings of this review may be used to help inform people of the risks and benefits of their choices.

LIMITATIONS

There is debate regarding how to assess risk of bias and methodological quality in clinical trials.⁶⁸

The variety of tools available, covering differing items/domains, suggest a lack of agreement regarding their relevance.⁶⁹ The Cochrane risk of bias tool was used in this review. Although widely used, this tool does have some acknowledged challenges; these include modest inter-rater agreement and how to deal with the risk of bias associated with funding/conflicts of interest.⁷⁰ In this review, inter-rater agreement was strong with both reviewers making similar judgements regarding the importance of potential sources of bias (92.31%, Kappa score of 0.836), and conflict of interest data are presented (table 2). The assessment of risk of bias in this review was influenced by the amount of incomplete or missing information in included studies⁷⁰ (table 2). This contributed to studies being rated as being at high risk of bias and, as the majority of studies were assessed as being at potentially high risk of bias, this limited the extent to which the objective of this review could be achieved.

Although we performed a thorough search of published literature, we did not perform a search of sources of grey literature

such as conference papers or government reports. As such, we acknowledge this as a potential source of publication bias within our literature search.

CONCLUSIONS

CS injections may have a short-term benefit (up to 8 weeks) over local anaesthetic injections alone in the management of RCRSP. However, the certainty of this conclusion is challenged due to variations in outcome measures and study design. Beyond 8 weeks, there was no evidence to suggest a benefit of CS over local anaesthetics.

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Contributors TC was the primary reviewer, extracted and analysed the data and was the primary author. CML contributed to the design of the review, editing support and guidance for the final manuscript. MM was the second reviewer. JL contributed to the conception and design of the review and editing of the final manuscript.

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REFERENCES

- Luime JJ, Koes BW, Hendriksen IJ, *et al.* Prevalence and incidence of shoulder pain in the general population; a systematic review. *Scand J Rheumatol* 2004;33:73–81.
- Taylor W. Musculoskeletal pain in the adult New Zealand population: prevalence and impact. *N Z Med J* 2005;118:U1629.
- Linsell L, Dawson J, Zondervan K, *et al.* Prevalence and incidence of adults consulting for shoulder conditions in UK primary care; patterns of diagnosis and referral. *Rheumatology* 2006;45:215–21.
- Greiving K, Dorrestijn O, Winters JC, *et al.* Incidence, prevalence, and consultation rates of shoulder complaints in general practice. *Scand J Rheumatol* 2012;41:150–5.
- van der Windt DA, Koes BW, Boeke AJ, *et al.* Shoulder disorders in general practice: prognostic indicators of outcome. *Br J Gen Pract* 1996;46:519–23.
- Lewis J. Rotator cuff related shoulder pain: assessment, management and uncertainties. *Man Ther* 2016;23:57–68.
- Neer CS. Impingement lesions. *Clin Orthop Relat Res* 1983;173:70–7.
- Lewis JS. Subacromial impingement syndrome: a musculoskeletal condition or a clinical illusion? *Physical Therapy Reviews* 2011;16:388–98.
- Lewis JS. Rotator cuff tendinopathy. *Br J Sports Med* 2009;43:236–41.
- Lewis JS. Rotator cuff tendinopathy: a model for the continuum of pathology and related management. *Br J Sports Med* 2010;44:918–23.
- Struyf F, Lluch E, Falla D, *et al.* Influence of shoulder pain on muscle function: implications for the assessment and therapy of shoulder disorders. *Eur J Appl Physiol* 2015;115:225–34.
- Sanchis MN, Lluch E, Nijs J, *et al.* The role of central sensitization in shoulder pain: a systematic literature review. *Semin Arthritis Rheum* 2015;44:710–6.
- Lewis J, McCreesh K, Roy JS, *et al.* Rotator Cuff Tendinopathy: navigating the diagnosis-management conundrum. *J Orthop Sports Phys Ther* 2015;45:923–37.
- Alvarez CM, Litchfield R, Jackowski D, *et al.* A prospective, double-blind, randomized clinical trial comparing subacromial injection of betamethasone and xylocaine to xylocaine alone in chronic rotator cuff tendinosis. *Am J Sports Med* 2005;33:255–62.
- Molini L, Mariacher S, Bianchi S. US guided corticosteroid injection into the subacromial-subdeltoid bursa: Technique and approach. *J Ultrasound* 2012;15:61–8.
- Cole BJ, Schumacher HR. Injectable corticosteroids in modern practice. *J Am Acad Orthop Surg* 2005;13:37–46.
- Carofino B, Chowaniec DM, McCarthy MB, *et al.* Corticosteroids and local anesthetics decrease positive effects of platelet-rich plasma: an in vitro study on human tendon cells. *Arthroscopy* 2012;28:711–9.
- Johansson A, Hao J, Sjölund B. Local corticosteroid application blocks transmission in normal nociceptive C-fibres. *Acta Anaesthesiol Scand* 1990;34:335–8.

What are the findings?

- ▶ Corticosteroid injections may confer superior benefit compared with anaesthetic-only injections in the short term (up to 8 weeks).
- ▶ Beyond 8 weeks, corticosteroid and anaesthetic-only injections had the same therapeutic effect for rotator cuff-related shoulder pain.
- ▶ It is unknown if improvement over time is due to placebo, natural history or a therapeutic effect of the medicines used in the published research.

How might it impact on clinical practice in the future?

- ▶ Both corticosteroid and anaesthetic-only injections may have short-term benefit for people considering injection therapy for rotator cuff-related shoulder pain.
- ▶ Corticosteroid injections may have a superior short-term therapeutic effect compared with anaesthetic-only injections, but not beyond that time point.
- ▶ The medium-term and long-term effects of corticosteroid and anaesthetic injections are equivocal.

- 19 Coombes BK, Bisset L, Vicenzino B. Efficacy and safety of corticosteroid injections and other injections for management of tendinopathy: a systematic review of randomised controlled trials. *Lancet* 2010;376:1751–67.
- 20 van der Sande R, Rinkel WD, Gebremariam L, *et al*. Subacromial impingement syndrome: effectiveness of pharmaceutical interventions-nonsteroidal anti-inflammatory drugs, corticosteroid, or other injections: a systematic review. *Arch Phys Med Rehabil* 2013;94:961–76.
- 21 Buchbinder R, Green S, Youd JM. Corticosteroid injections for shoulder pain. *Cochrane Database Syst Rev* 2003;CD004016.
- 22 Gaujoux-Viala C, Dougados M, Gossec L. Efficacy and safety of steroid injections for shoulder and elbow tendonitis: a meta-analysis of randomised controlled trials. *Ann Rheum Dis* 2009;68:1843–9.
- 23 Mohamadi A, Chan JJ, Claessen FM, *et al*. Corticosteroid injections give small and transient pain relief in rotator cuff tendinosis: a meta-analysis. *Clin Orthop Relat Res* 2017;475:232–43.
- 24 Arroll B, Goodyear-Smith F. Corticosteroid injections for painful shoulder: a meta-analysis. *Br J Gen Pract* 2005;55:224–8.
- 25 Bhatia M, Singh B, Nicolaou N, *et al*. Correlation between rotator cuff tears and repeated subacromial steroid injections: a case-controlled study. *Ann R Coll Surg Engl* 2009;91:414–6.
- 26 Dean BJ, Franklin SL, Murphy RJ, *et al*. Glucocorticoids induce specific ion-channel-mediated toxicity in human rotator cuff tendon: a mechanism underpinning the ultimately deleterious effect of steroid injection in tendinopathy? *Br J Sports Med* 2014;48:1620–6.
- 27 Poulsen RC, Watts AC, Murphy RJ, *et al*. Glucocorticoids induce senescence in primary human tenocytes by inhibition of sirtuin 1 and activation of the p53/p21 pathway: in vivo and in vitro evidence. *Ann Rheum Dis* 2014;73:1405–13.
- 28 Harris JD, Quatman CE, Manring MM, *et al*. How to write a systematic review. *Am J Sports Med* 2014;42:2761–8.
- 29 Higgins JP, Altman DG, Gøtzsche PC, *et al*. The cochrane collaboration's tool for assessing risk of bias in randomised trials. *BMJ* 2011;343:d5928.
- 30 Liberati A, Altman DG, Tetzlaff J, *et al*. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ* 2009;339:b2700.
- 31 van der Heijden GJ, van der Windt DA, Kleijnen J, *et al*. Steroid injections for shoulder disorders: a systematic review of randomized clinical trials. *Br J Gen Pract* 1996;46:309–16.
- 32 Bloom JE, Rischin A, Johnston RV, *et al*. Image-guided versus blind glucocorticoid injection for shoulder pain. *Cochrane Database Syst Rev* 2012;8:CD009147.
- 33 Ekeberg OM, Bautz-Holter E, Tveit EK, *et al*. Subacromial ultrasound guided or systemic steroid injection for rotator cuff disease: randomised double blind study. *BMJ* 2009;338:a3112.
- 34 van Tulder M, Furlan A, Bombardier C, *et al*. Updated method guidelines for systematic reviews in the cochrane collaboration back review group. *Spine* 2003;28:1290–9.
- 35 Imran M, Narla H, Wick JA, *et al*. Comparison of corticosteroid plus lidocaine or lidocaine alone in patients receiving celecoxib for the treatment of acute shoulder or trochanteric bursitis: A randomized, double-blind, placebo controlled trial. *Arthritis and Rheumatism* 2049.
- 36 Kirkley A, Litchfield R, Alvarez C, *et al*. Prospective double blind randomized clinical trial of subacromial injection of betamethasone and xylocaine versus xylocaine alone in rotator cuff tendinosis. *J Bone Joint Surg* 1999;81-B(Supplement 1).
- 37 Alvarez-Nemegyei J, Bassol-Perea A, Rosado Pasos J. Efficacy of the local injection of methylprednisolone acetate in the subacromial impingement syndrome. A randomized, double-blind trial. *Reumatol Clin* 2008;4:49–54.
- 38 Ströbel G. Long-term therapeutic effect of different intra-articular injection treatments of the painful shoulder-effect on pain, mobility and work capacity. *Rehabilitation* 1996;35:176–8.
- 39 Higgins JPT, Green SE. *Cochrane handbook for systematic reviews of interventions version 5.0.1*. Chichester: The Cochrane Collaboration, John Wiley and Sons, 2011.
- 40 Furlan AD, Malmivaara A, Chou R, *et al*. 2015 Updated Method Guideline for Systematic Reviews in the Cochrane Back and Neck Group. *Spine* 2015;40:1660–73.
- 41 McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med* 2012;22:276–82.
- 42 van Tulder MW, Esmail R, Bombardier C, *et al*. Back schools for non-specific low back pain. *Cochrane Database Syst Rev* 1999.
- 43 Holt TA, Mant D, Carr A, *et al*. Corticosteroid injection for shoulder pain: single-blind randomized pilot trial in primary care. *Trials* 2013;14:425.
- 44 Penning LI, de Bie RA, Walenkamp GH. Subacromial triamcinolone acetate, hyaluronic acid and saline injections for shoulder pain an RCT investigating the effectiveness in the first days. *BMC Musculoskelet Disord* 2014;15:352.
- 45 Richardson AT. Ernest Fletcher Lecture. The painful shoulder. *Proc R Soc Med* 1975;68:731–6.
- 46 Lin YH, Chiou HJ, Wang HK, *et al*. Comparison of the analgesic effect of xylocaine only with xylocaine and corticosteroid injection after ultrasonographically-guided percutaneous treatment for rotator cuff calcific tendinosis. *J Chin Med Assoc* 2015;78:127–32.
- 47 Withrington RH, Giris FL, Seifert MH. A placebo-controlled trial of steroid injections in the treatment of supraspinatus tendonitis. *Scand J Rheumatol* 1985;14:76–8.
- 48 Adebajo AO, Nash P, Hazleman BL. A prospective double blind dummy placebo controlled study comparing triamcinolone hexacetate injection with oral diclofenac 50 mg TDS in patients with rotator cuff tendinitis. *J Rheumatol* 1990;17:1207–10.
- 49 Petri M, Dobrow R, Neiman R, *et al*. Randomized, double-blind, placebo-controlled study of the treatment of the painful shoulder. *Arthritis Rheum* 1987;30:1040–5.
- 50 Plafki C, Steffen R, Willburger RE, *et al*. Local anaesthetic injection with and without corticosteroids for subacromial impingement syndrome. *Int Orthop* 2000;24:40–2.
- 51 Hong JY, Yoon SH, Moon DJ, *et al*. Comparison of high- and low-dose corticosteroid in subacromial injection for periarticular shoulder disorder: a randomized, triple-blind, placebo-controlled trial. *Arch Phys Med Rehabil* 2011;92:1951–60.
- 52 Akgün K, Birtane M, Akarim U. Is local subacromial corticosteroid injection beneficial in subacromial impingement syndrome? *Clin Rheumatol* 2004;23:496–500.
- 53 Penning LI, de Bie RA, Walenkamp GH. The effectiveness of injections of hyaluronic acid or corticosteroid in patients with subacromial impingement: a three-arm randomised controlled trial. *J Bone Joint Surg Br* 2012;94:1246–52.
- 54 Watson J, Helliwell P, Morton V, *et al*. Shoulder acute pain in primary healthcare: is retraining effective for GP principals? SAPHIRE-a randomized controlled trial. *Rheumatology* 2008;47:1795–802.
- 55 McInerney JJ, Dias J, Durham S, *et al*. Randomised controlled trial of single, subacromial injection of methylprednisolone in patients with persistent, post-traumatic impingement of the shoulder. *Emerg Med J* 2003;20:218–21.
- 56 Vecchio PC, Hazleman BL, King RH. A double-blind trial comparing subacromial methylprednisolone and lignocaine in acute rotator cuff tendinitis. *Br J Rheumatol* 1993;32:743–5.
- 57 Blair B, Rokito AS, Cuomo F, *et al*. Efficacy of injections of corticosteroids for subacromial impingement syndrome. *J Bone Joint Surg Am* 1996;78:1685–9.
- 58 Scherb MB, Han SH, Courneya JP, *et al*. Effect of bupivacaine on cultured tenocytes. *Orthopedics* 2009;32:26–.
- 59 Honda H, Gotoh M, Kanazawa T, *et al*. Effects of lidocaine on torn rotator cuff tendons. *J Orthop Res* 2016;34:1620–7.
- 60 Screen H. *et al* Tendon and tendon pathology. In: Jull G, Moore A, Falla D, eds. *Grieve's modern musculoskeletal physiotherapy*. 4th edn. London: Elsevier, 2015.
- 61 Scott A, Backman LJ, Speed C. Tendinopathy: update on pathophysiology. *J Orthop Sports Phys Ther* 2015;45:833–41.
- 62 Saunders S, Longworth S. *Injection techniques in musculoskeletal medicine: A practical manual for clinicians in primary and secondary care. Fourth edition*. UK: Churchill Livingstone Elsevier, 2012:5.
- 63 Health and Social Care Information Centre. Prescription cost analysis England 2014. 2015 <http://www.hscic.gov.uk> (accessed 8 Apr 2015).
- 64 Committee JF. *British national formulary*. 68th edn. London: BMJ Group and Pharmaceutical Press, 2014.
- 65 Ramirez J, Pomés I, Cabrera S, *et al*. Incidence of full-thickness rotator cuff tear after subacromial corticosteroid injection: a 12-week prospective study. *Mod Rheumatol* 2014;24:667–70.
- 66 Coombes BK, Bisset L, Brooks P, *et al*. Effect of corticosteroid injection, physiotherapy, or both on clinical outcomes in patients with unilateral lateral epicondylalgia: a randomized controlled trial. *JAMA* 2013;309:461–9.
- 67 Wu T, Song HX, Dong Y, *et al*. Ultrasound-guided versus blind subacromial-subdeltoid bursa injection in adults with shoulder pain: A systematic review and meta-analysis. *Semin Arthritis Rheum* 2015;45:374–8.
- 68 Armijo-Olivo S, da Costa BR, Cummings GG, *et al*. PEDro or cochrane to assess the quality of clinical trials? A meta-epidemiological study. *PLoS One* 2015;10:e0132634.
- 69 Olivo SA, Macedo LG, Gadotti IC, *et al*. Scales to assess the quality of randomized controlled trials: a systematic review. *Phys Ther* 2008;88:156–75.
- 70 Jørgensen L, Paludan-Müller AS, Laursen DR, *et al*. Evaluation of the cochrane tool for assessing risk of bias in randomized clinical trials: overview of published comments and analysis of user practice in cochrane and non-cochrane reviews. *Syst Rev* 2016;5:80.



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